HOT 341: Chief Scientist Report

Chief Scientist: Tully Rohrer
R/V *Kilo Moana*
March 27th – April 1st, 2023

Cruise ID: KM 23-05
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Christopher Amorant
Chief Scientist: Tully Rohrer, University of Hawaii
Marine Technicians: Trevor Young (lead), James Harris

1.0 COVID-19 PREVENTION

Due to the current COVID-19 pandemic extra precautions were set in place before and during the cruise to prevent the spread of COVID-19 onboard. UNOLS has provided guidelines which were followed on this cruise. A few of the guidelines are found below. The extensive list can be found in the Pandemic Response Plan.

- All science party were vaccinated.
- All cruise participants self-isolated according to the HOT Risk Mitigation Plan.
- All cruise participants were Antigen tested for COVID.

2.0 SCIENTIFIC OBJECTIVES

The cruise objective was to maintain a collection of hydrographic and biogeochemical data at the Hawaii Ocean Time-series (HOT) stations.

A copy of the detailed cruise plan is available at:

https://hahana.soest.hawaii.edu/hot/crsplan/HOT_341_Operational_Cruise_plan.pdf

Science operations were planned for 4 stations, in the following order:

1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W.
2) Station 2, referred to as Station ALOHA, is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. This is the main HOT station.
3) Station 52, the site of WHOTS-18 Mooring (anchor position 22° 40.021'N, 157° 57.078'W).
4) Station 6, referred to as Station Kaena, is located off Kaena Point at 21° 50.8'N, 158° 21.8'W.

3.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Camille Adkison	Graduate Student	UH	USA
Eleanor Bates	Graduate Student	UH	USA
Karin Björkman	Research Specialist	UH	SWE
Brandon Brenes	Research Associate	UH	USA
Tim Burrell	Research Associate	UH/SCOPE	NZL
Madeline Davis	Graduate Student	UH	USA

Peter Farrell	Graduate Student	NIOZ	IRL
Carolina Funkey	Research Associate	UH	USA
Eric Grabowski	Research Associate	UH	USA
James Harris	Marine Technician	UH	USA
Devin Hogate	Undergraduate Student	UH	USA
Andrew Hirzel	Postdoc	UH	USA
Charlotte Kollman	Graduate Student	UGA	USA
Christopher Marsay	Scientist	UGA	GBR
Nicole Mathews	Undergraduate Student	UH	USA
Daniel Ohnemus	Scientist	UGA	USA
Fernando Carvalho Pacheco	Research Associate	UH	BRA
Tully Rohrer	Research Associate	UH/SCOPE	USA
Dan Sadler	Research Associate	UH	USA
Fernando Santiago-Mandujano	Research Associate	UH	USA
Ryan Tabata	Research Associate	UH/SCOPE	USA
Blake Watkins	Marine Engineer	UH	USA
Trevor Young	Marine Technician	OTG	USA

4.0. GENERAL SUMMARY

Equipment loading was conducted on Friday, March 24th. There was one personnel change between loading and departure, as Fernando Santiago-Mandujano replaced Dan Fitzgerald for the Physical Oceanography group.

The cruise departed on time on March 27th. Operations at Station Kahe were conducted as planned, which included a weight cast, a Hyperpro deployment, a CTD cast, and a Trace Metal CTD cast. We departed Station Kahe at 15:30 and arrived at Station ALOHA at 23:30. Currents were 1.4 knots to the northeast, so we deployed the Net Trap array three miles west of center circle and moved northeast a mile between deployments of the Wire Walker and sediment trap arrays.

Afterwards, a 200m CTD cast was conducted to find the mixed layer depth for the UGA group, followed by a large volume water collection by submersible pump to get a UGA Beryllium-7 profile. Then Seagliders 511 and 513 were deployed, and a VPR yo-yo cast was conducted. The UGA group was then able to deploy their McLane pumps. By the time the pumps were recovered to deck, the Net Trap array had drifted nine miles to the NE, which led to a recovery that began well after dark. Conditions proved challenging with winds gusting to 25 kts from the SE, currents strong to the NE, and plentiful lightning nearby, and multiple approaches were attempted before recovery was successfully completed at 2200. This delay led to the postponement of the N-cast, and the abridgement of the WHOTS anchor bathymetry survey.

A CTD was conducted to collect water for the primary productivity array, and the array was deployed east of station center. The PO deep cast and a Trace Metal cast were performed. During the PO shallow cast, a ship-wide power outage occurred. Power was out for two minutes, during which the CTD's battery backup power supply allowed for continued data-gathering. The cast was delayed a further 16 minutes while power to the ship's propulsion was restored, and then the cast was completed. A Hyperpro cast and two more CTDs were performed before transiting for the primary productivity array, which had drifted just to the NE of ALOHA circle.

Unfortunately, during recovery at 19:32, the primary productivity array snagged in the ship's port propeller. Efforts to move the ship and pull the array forward away from the propeller were not successful. An underwater camera was used on the end of a boat pole to assess the situation, which showed that the array was twisted around two blades of the propeller. The SeaMac winch was clipped into the array, and tension was pulled to provide an opportunity to cut the line and free the array's floats. While the cutting was not successful, a shackle attached to the deepest float broke at 22:20, allowing for retrieval of the buoy and all floats but one. The buoy was heavily damaged throughout this process, losing the mast and all the communications equipment. Further camera work showed that the array remained tangled around ship's propeller, and that the bulk of the array may still have been trailing off the ship's rudder. At this point, the captain decided that there would be an operational stand down until daylight so that the camera could get better images of the situation.

Troubleshooting began again at daybreak, and camera images showed that the array was indeed trailing off the ship's rudder. A weighted grappling hook attached to the A-frame was dropped forward of the ship's port quarter and reeled in by hand. On the third attempt, the array line was successfully snagged and reeled in such that the 25m samples were retrieved and the line was transferred to a direct connection to the winch. The line trailing from the rudder was cut, and the rest of the primary productivity array was recovered at 09:30, with only the 5m samples being lost. After recovery, the camera showed that the line (approximately 20m) was still tangled around the propeller and trailing aft, but was wrapped around only two blades of the propeller, and not around the propeller shaft. This allowed for the engagement of the port propeller, and after slowly bringing it up to speed and transiting north towards the other arrays, the propeller successfully shed the line and allowed for a return to operations.

The Wire Walker and sediment trap arrays were recovered approximately 18 miles from where they were deployed, well north of Station ALOHA at 13:42 and 14:48, respectively. Seaglider 513's recovery was quite challenging, with the ship backing up into rough seas and taking water up onto the stern. After an hour's worth of efforts, the glider was successfully recovered at 17:48. The N-cast was performed in the same spot immediately after the seaglider was recovered. The ship then transited back to ALOHA circle.

CTD casts resumed and all water sampling was successfully performed except for the Gas Array (cancelled due to conditions) and Station Kaena (cancelled due to timing). Because of the delays due to troubleshooting the primary productivity array, the 36-hour CTD burst period was not completed. At Station ALOHA, two near bottom CTD casts, ten 1000 m CTD casts, one 200 m cast, and one 300 m High Res cast were completed (with the High Res cast performed outside the ALOHA circle).

Four net tows for the core HOT zooplankton collection were completed: two during the day and two at night.

Four trace-metal casts were completed.

The 300 kHz and 38 kHz ADCPs, underway fluorometer, transmissometer, thermosalinograph and the ship's meteorological suite ran with one interruption due to the power outage. There is also some evidence that the 38 kHz ADCP's range may be affected by biofouling.

Winds during the cruise were 20 knots from the SE. There was 2-3 m groundswell and rain occasionally as listed in the schedule summary below. A NE to NNE surface current of 1 kt was present throughout the cruise.

5.0. R/V *Kilo Moana* OFFICERS AND CREW, TECHNICAL SUPPORT

The R/V *Kilo Moana* continues to maintain ship support for our work. Captain Amorant and the ship's crew showed flexibility, enthusiasm, concern, and dedication to our scientific mission.

Technical support during this cruise was very good. OTG personnel were available to assist in our work during the cruise, and were particularly helpful in filming and freeing the snagged primary productivity array. They were flexible and accommodating.

6.0. DAILY REPORT OF ACTIVITIES (HST)

March 27th, 2023

0845 - Depart Pier 35
0945 - Safety briefing and drills
1135 - Arrive Station Kahe, LARS Testing
1156-1225 - Weight Cast
1239-1311 - Hyperpro Cast
1321-1435 - S1C1
1458-1512 - Trace Metal Cast #1
1519 - Transit to Station ALOHA
2300 - Arrive ALOHA Circle
2325 - Arrive Net Trap Deployment Location, Prep Net Trap
2357- Deploy Net Trap Array, 22° 45.116'N, 158° 3.304'W

March 28th, 2023
0008 - Transit 1 mi NE
0037-0048 - Deploy WireWalker, 22° 45.960'N, 158° 2.375'W
0049 - Transit 1 mi NE
0119-0159 - Deploy Sediment Trap Array, 22° 46.870'N, 158° 1.496'W
0202 - Transit 3 mi SE to CTD site
0253-0319 - Begin S2C1, 200m cast for UGA
0351-0722 - UGA Be-7 Pumping
0815 - Deployed Seaglider 511
0841 - Deployed Seaglider 513
0952-1141 - VPR Cast
1146 - Transit to Pump Tanks
1248 - Arrive back to ALOHA circle
1354-1811 - McLane pump recovery
1815 - Transit to Net Trap Array (~9 mi)
1915 - Arrive Net Trap Array, assess currents/wind
1945 - Trip Net Trap Array acoustic release

1950 - Begin Net Trap Array approach
2130 - Hook on, begin Net Trap Array recovery
2147 - End Net Trap Array recovery, 22° 54.798'N, 157° 55.509'W
2150 - Transit to Pump Tanks
2215 - Transit to WHOTS Anchor Site
2309 - Raining on Station

March 29th, 2023
0034-0120 - WHOTS Anchor bathymetry survey
0120 - Transit to Primary Productivity cast site
0159-0259 - S2C2, Primary Productivity cast
0410-0440 - Primary Productivity array deployment, 22° 44.979'N, 157° 57.614'W
0500 - Raining on station
0519 - Begin S2C3, PO Deep Cast
0658 - Bottom of deep cast, 4800 db
0820 - Raining on station
0857 - End S2C3
0919-0947 - Trace Metal Cast #2
1058 - Begin S2C4, PO Shallow Cast
1200 - Power outage on ship - CTD cast continued on battery backup
1202 - Power restored
1218 - Continue CTD cast, drifted 0.2 mi from center circle due to power outage
1241 - End S2C4
1257-1335 - Hyperpro Cast
1354-1502 - S2C5, PC/PN Cast
1514 - Transit to Pump Tanks
1630 - Back into ALOHA circle
1653-1756 - S2C6, PPO4 cast
1805 - Transit to PP Array
1853 - Begin PP Array Recovery
1932 - Hook On, PP Array hung up on rudder/propeller
1935-2220 - Troubleshooting snagged array
2220 - Array floats break free, begin camera work to assess if array parts still snagged
2230 - Confirm line still caught in port propulsion, science operations standby

March 30th, 2023
0700-0900 - Camera work and discussions regarding effort to free the propeller
0915 - Grappling hook successfully attached to stuck array line
0930 - Primary Productivity array recovered, 5m samples lost
1000-1100 - Camera work reveals line still on propeller
1100 - Transit towards WW and ST arrays allowing for propeller to free itself from the line
1230 - Camera shows propeller free from line
1330-1342 - WireWalker recovery, 23° 3.749'N, 157° 57.760'W
1343 - Transit to Sediment Trap array
1425-1448 - Sediment Trap array recovery, 23° 4.699'N, 157° 59.814'W
1510 - Transit to Seaglider 513
1641 - Glider sighted, begin approach
1748 - Glider recovered, 22° 54.208'N, 157 51.994'W

1810-1910 - S2C7, N-cast to 300m, outside ALOHA circle
1915 - Transit back to ALOHA circle, pump tanks
2015-2046 - Trace Metal Cast #3
2107-2234 - S2C8, BEACH cast
2310 - Begin Net Tows

March 31st, 2023
0007 - End Net Tows (2)
0053-0203 - S2C9, HPLC Cast
0210-0337 - VPR Cast
0426-0532 - S2C10, SCOPE DNA Cast, PSi Cast
0539 - Transit to Pump Tanks
0800-0924 - S52C1, WHOTS Yo-yo Cast
0942-1009 - Trace Metal Cast #4
1217-1326 - Net Tows
1351-1454 - S2C11, ATP Cast
1501 - Transit to center of ALOHA circle
1604-1919 - S2C12, PO Deep Cast #2
1930 - Transit to Pier 35

April 1st, 2023

0800 – First line, starboard side to dock to allow for Trace Metal Van offload
0930 – First line, port side to dock, begin offload

HOT program sub-components:

Investigator	**Project**	**Institution**
Angelicque White	Core Biogeochemistry	UH
Dave Karl	SCOPE-biogeochemistry	UH
John Dore	Biogeochemistry QA/QC	MSU
James Potemra	Hydrography	UH
Mike Landry	Zooplankton dynamics	SIO
Ricardo Letelier	Optical measurements	OSU

Ancillary programs:

Ed DeLong	SCOPE: DNA and Viral DNA collection	UH

Andrew Dickson	CO_2 dynamics and intercalibration	SIO
Paul Quay	$DI^{13}C$	UW
Dan Repeta	SCOPE: DOM collection	WHOI
Nicholas Hawco Eleanor Bates	Quantifying Iron Turnover in the Upper Ocean via Time-series Measurements at Station ALOHA	UH
Sonya Dyhrman	Physiological ecology of diatom diazotroph associations using metatranscriptome samples.	LDEO
Debbie Lindell	Seasonal Virus Sampling	Technion
Dan Ohnemus Chris Marsay Charlotte Kollman	Hawaii Aerosol Time-Series: Quantifying marine dust deposition and composition in an oligotrophic gyre	UGA
Dave Karl Eric Grabowski	High Resolution CTD cast, Net Trap Array	UH
Madeline Davis	Micro Sequential Injection Analysis (Mini-SIA) for Analyzing Phosphate and Silicate	UH
Kelsey McBeain Grieg Steward	Isolating heterotrophic eukaryotes for growth on prochlorococcus and pelagibacter	UH
Moritz Lehmann	Nitrate Isotope Analyses	Unibas
Rhea Foreman	Nitrite Analysis linked to Nitrifier DNA Samples	UH